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The gendered interplay between intellectual abilities, metacognition and academic performance of rural adolescents

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Abstract
The principal aim of this study was to investigate gender differences in the interplay among intellectual abilities, metacognition and academic performance of rural adolescents (13-16 years). The study was conducted in the Government schools in villages of Ludhiana-I Block. The final sample comprised 240 rural school-going adolescents (N=240) studying in grade 7th, 8th, 9th and 10th. The subjects were equally distributed across both the genders (Males=120 & Females=120) and all the grades. A Self-Structured Metacognitive Questionnaire adapted from Metacognition Inventory (Govil 2003) and Metacognitive Awareness Inventory (Schraw and Dennison 1994) was used to assess the metacognitive skills of the adolescents. Intellectual abilities of the selected subjects were analysed through Raven's Standard Progressive Matrices (Raven 1960) and academic performance was determined through aggregate percentage of marks/grades obtained by the subject in the last school examination substantiated by teacher ratings. The investigations brought to light that irrespective of gender, 'Metacognitive skills' were significantly impacting the 'Academic Performance' of the rural adolescents, but the impact of 'Intellectual Abilities' on 'Academic performance' could not be established.

Keywords: Knowledge of cognition, regulation of cognition, intellectual abilities, academic performance

1. Introduction
Over the past two decades, "metacognition" has emerged as a major focus of research interest in cognitive psychology. The conceptualization of this construct has expanded and investigations and empirical research abound into various facets of this domain. Metacognition is a term that was coined by Flavell in 1970s. It refers to the people's awareness of their own cognitive machinery and how it works (Meichenbaum *et al* 1985) [13]. Metacognition literally means 'cognition about cognition' or 'knowledge about knowing and learning'. Although related, cognition and metacognition differ: Cognitive skills are those needed to perform a task whereas metacognitive skills are necessary to understand how it was performed. In teaching and learning situations, metacognition has been found to be especially important because it affects acquisition, comprehension, retention and application of what is learned in addition to affecting learning efficiency, critical thinking and problem solving. Metacognitive awareness enables control or self-regulation over thinking and learning processes and products (Hartman 1998) [8]. Further, metacognitive abilities help in estimating one's knowledge related to academic achievement in college. While in college the students learn a great deal of new knowledge and over the time successful students learn to update their knowledge as new concepts, facts, and procedures are acquired. Also, Gourgey (1998) [6] described self-regulatory processes that promote achievement in the basic skills of reading and mathematical problem solving. Metacognition was described as integrated with reading and mathematics instruction and students' reactions to learning to think met cognitively. Thus, not all differences in metacognitive abilities have to do with age or maturation. There is great variability even among students of the same developmental level but these differences do not appear to be related to intellectual abilities. In fact, superior metacognitive skills can compensate for lower levels of ability, so these metacognitive skills can be especially important for students who often have trouble in school (Schunk 2000; Swanson 1990) [21, 27]. However, Schraw (1998) [18] described two aspects of metacognition, namely 'knowledge of cognition' and 'regulation of cognition' and how they were related to domain-specific knowledge cognitive abilities. He argued that metacognitive knowledge was multidimensional

domain-general in nature and teachable. He described four instructional strategies that include promoting general awareness, improving self-knowledge and regulatory skills and learning environments. `Also, the successful learners employ a range of metacognitive skills and effective teachers attend to the development of these skills. The learners who are skilled in metacognitive self-assessment and are therefore aware of their abilities are more strategic and perform better than those who are unaware. Metacognition enables us to be successful learners, and has also been associated with intelligence (Borkowski *et al* 1987; Sternberg 1984, 1986a, 1986b) [1, 26].

The studies on metacognition by itself cannot solve the problems of learning, especially the complex ones but these can be used as a tool for aggravating results in education. Although some published materials now include activities which get students to review what they have learnt (Sinclair and Ellis 1992) [22] these are often in the form of self-tests or check lists which focus solely on the product or the linguistic content of a learning unit and not, in any way, on the processes involved. The emphasis here is "on learning something rather than on learning to learn" (Weyden 1985) [30].

Rozencwajg (2003) [17] studied the relationship of metacognitive levels of 12 to 13 aged with their performance in solving problems of science in school. Two indicators of metacognition were established that is (a) Meta-knowledge about learning in the classroom and (b) metacognitive monitoring of the difficulty of the problem proposed in academic research. The two indicators were related to student performance on IQ tests and strategies for solving problems of electricity. The results showed that 'meta-knowledge' was related to crystallized intelligence, whereas 'metacognitive monitoring' appeared associated with fluid intelligence. However, both indicators were strongly related to metacognitive strategies for solving scientific problems.

Metacognition can also exert influence on motivation (Jones 1988), because the fact that the students can control and manage their own cognitive processes gives them the sense of responsibility for their academic achievement and builds confidence in their own abilities (Mitchell &Valente 1991) [14].

Thus, metacognition like intelligence is a broad concept that represents a number of specific aspects. Metacognitive training is a crucial aspect of developing reflection, autonomous learning and construction of knowledge on the part of teachers and students. Therefore, it is important to identify students with low learning awareness and design specific intervention programs for strengthening metacognitive strategies in the area of learning. Currently there are meager attempts in this direction.

Intellectual ability is regarded as the acquired repertoire of general cognitive skills that is available to a person at a particular point of time (Snow & Lohman 1984) [23]. Intelligence is the simple accrual and tuning of many small units of knowledge that in total produce complex cognition.

Intellectual ability and metacognition are acknowledged to be the two important determinants for learning. Metacognitive awareness and skills are proved to be linked to academic performance having highly positive effect on improving the results, possible to develop and to improve with training independent of student's intellectual ability. Hence, metacognition is essential for successful learning as it enables individuals to better manage their cognitive skills and to determine weaknesses that can be corrected by constructing new cognitive skills. Prins *et al* (2006) [15] also found that metacognitive skillfulness rather than intellectual ability appears essential for learning when learners operate at the boundary of their knowledge.

The relationship of intellectual abilities and academic performance is well documented, but metacognition as a mediating factor has not been adequately investigated. Thus, in teaching-learning situation the focus is only on the development of intellectual abilities of the children so as to enhance their academic performance. But the current researches indicate that metacognitive skillfulness develops alongside, but not fully dependent on intellectual ability and outweighs intelligence as predictor of academic performance. Therefore, it becomes imperative to study the interplay among these variables and identify the gender differentials if any, to understand the relative contribution and significance of each variable in enhancing the academic performance of the adolescents.

2. Objectives

a. To examine gender differentials in the level of intellectual abilities, metacognition and academic performance of rural adolescents.
b. To explore gender differences in the relationship between intellectual abilities, metacognitive skills and academic performance of rural adolescents.

3. Materials and Methods

3.1 Locale of the study: The current study was carried out in the rural Government Schools of Ludhiana district. For selection of the sample, a complete list of villages of Ludhiana block-I having Government High Schools/ Government Senior Secondary Schools was obtained from the Office of District Education Officer, Ludhiana. Out of this list, three schools were randomly selected (viz. Government Senior Secondary School, Ayalli Khurd, Government Secondary School, Jassian Village & Government Senior Secondary School, Churpur Village, Ludhiana).

3.2 Selection of the sample: The sample for the study comprised 240 rural school going adolescents aged 13 to 16 years (N=240) studying in grade 7^{th} to 10^{th}. For this purpose, the concerned teachers were approached to obtain the complete list of the students studying in 7^{th} to 10^{th} grade. The subjects were equally drawn from each class and were equally distributed across both the genders (Males=120 and Females=120).

3.3 Research instruments: The following tools were used for various assessments of the selected rural adolescents:

a. Self-structured metacognitive questionnaire

Metacognitive skillfulness among adolescents was assessed through a self-structured Metacognitive Questionnaire adapted from Metacognition Inventory (Govil 2003) [7] and Metacognitive Awareness Inventory (MAI) developed by Schraw and Dennison (1994) [18]. The questionnaire was designed to investigate two components of metacognition that is 'Knowledge of Cognition' & 'Knowledge of Regulation'. The self-structured Metacognitive Questionnaire was pre-tested and translated to Punjabi vernacular before its final use for the ease of comprehension of rural adolescents.

b. Raven's standard progressive matrices (Raven 1960) [16]
Raven's Standard Progressive Matrices (Raven 1960) [16] was used to assess the intellectual abilities of the selected subjects, whereas the academic performance was assessed through aggregate percentage of marks/grades achieved by the subject in the last school examination substantiated by teacher ratings.

3.3 Statistical analysis of data
Arithmetic mean, percentages, standard deviation, coefficient of variation, chi-square test, t-test, Z-test and linear regression were used to analyze the data.

4. Results and Discussion
4.1 Gender differentials in the level of intellectual abilities, metacognitive skills and academic performance of rural adolescents
Table 1 depicts the differences in mean scores (±SD) of male and female respondents across the two components of metacognition. The data presented in the table reveals statistically non-significant gender differences in both the components (Knowledge of Cognition & Regulation of Cognition) of metacognition. However, irrespective of the components statistically significant differences were observed in overall metacognition where female respondents had higher mean scores than their male counterparts. This indicates the superiority of the rural females in metacognitive skilfulness.
Liliana and Lavinia (2011) [12] also investigated the potential gender differences regarding the metacognitive skills of 8th graders. The findings indicated that generally both girls and boys used their metacognitive skills in learning. In addition, the results indicated that there were significant differences between boys and girls with regards to their planning, knowledge about one's own intellectual strengths and weaknesses as well as the use of various learning strategies and monitoring the learning process. However, in contradiction to these findings Jaleel and Premachandran (2006) [9] also examined the metacognitive awareness of secondary school students and the study showed that there was no significant difference in the metacognitive awareness of secondary school students based on their gender, locality and type of management. So whatever needed are innovative teaching methods and learning activities that arouse and develop the metacognitive level of students.

Table 1: Gender-wise distribution of mean scores (±SD) across two components of metacognition among rural adolescents (N=240)

Components of Metacognition	Male Mean ±SD	Female Mean ±SD	t-value	Overall Mean ±SD
I- Knowledge of Cognition	2.10±0.38	2.19±0.39	1.81	2.14±0.39
II-Regulation of Cognition	2.07±0.38	2.17±1.16	0.90	2.12±0.39
Overall Metacognition	2.08±0.30	2.18±0.30	2.58*	2.13±0.30

*Significant difference at 0.05

Table 2 exhibits the gender-wise percent distribution of respondents across varying levels of Intellectual Abilities as designated in Raven's Standard Progressive Matrices (Raven 1960) [16]. The data presented in the table revealed statistically non-significant differences in the intellectual abilities of boys and girls. Although both the genders were found to be at par in their intellectual abilities yet it could be observed that more number of girls were at superior level of intellectual abilities in contrast to boys who were concentrated more at above average and average level of intellectual abilities.

Table 2: Gender-wise percent distribution of respondents across varying levels of intellectual abilities (N=240)

Levels of Intellectual Abilities	Male (n=120)		Female (n=120)		Z-value
	f	%	f	%	
Superior	25	20.83	38	31.67	1.91
Above Average	42	35.00	31	25.83	1.54
Average	46	38.33	33	27.50	1.79
Below Average	4	3.33	10	8.33	1.65
Defective	3	2.50	8	6.67	1.54

**Significant difference at 0.01

Table 3 reflects the gender-wise percent distribution of respondents according to the levels of Academic Performance. The data depicts statistically non-significant gender differences at all the levels of academic performance but it is evident from the data that slightly higher number (40%) of female subjects were in Grade A in contrast to the male subjects who showed up in higher proportion (70%) in Grade D. This picture is more or less similar to the one presented in Table 2 with respect to the intellectual abilities of the respondents.
These results are in contradiction to the investigations conducted by Veas *et al* (2016) [28] who examined the predictive effects of gender, intellectual ability, self-concept, motivation, learning strategies, popularity and parent involvement on academic achievement. Results confirmed that girls appeared to have established themselves as more reliable in terms of passing grades than their male peers. This situation begun by the mid-1990s, as boys began to emerge as significantly less successful than girls in terms of learning outcomes. Also, the study indicated that intellectual ability was a strong predictor for academic achievement, similar to previous findings.

Table 3: Gender-wise percent distribution of respondents across varying levels of academic performance (N=240)

Levels of Academic Performance	Male (n=120)		Female (n=120)		Z-value
	f	%	f	%	
Grade A	37	30.83	48	40.00	1.49
Grade B	51	42.50	47	39.17	0.53
Grade C	20	16.67	20	16.67	NA
Grade D	12	10.00	5	4.17	1.76

4.2 Gender differentials in the interrelationship between intellectual abilities, metacognitive skills and academic performance of rural adolescents
Under this objective, gender-wise impact analysis of the three variables under study namely intellectual abilities, metacognitive skills and academic performance of rural adolescents was attempted. For estimating the relationships among these variables, Tables 4 through 6 present regression analysis of the selected variables. Table 4 focuses on the impact of Academic Performance and Metacognitive Skills (independent variables) on the Intellectual Ability (dependent variable) of the respondents. The review of the regression

analysis presented in this table depicts no significant impact of the 'Academic Performance' and 'Metacognitive skills' on the 'Intellectual ability' of the rural adolescents. This indicates that the value of the 'Intellectual Ability' (dependent variable) did not change significantly with variation in any of the independent variable (Academic Performance or Metacognitive Skills), while the other independent variable was held constant. Thus, no contributing relationship of the 'Academic Performance' and 'Metacognitive Skills' (independent variables) towards 'Intellectual Ability' (dependent variable) could be established across the two genders as well as in totality.

Table 4: Linear regression analysis of Academic Performance (AP) and Metacognitive Skills (MS) on Intellectual Ability (IA) of Rural Adolescents (N=240)

Variables	Male		Female		Combined	
	Regression coefficient (β)	t-value	Regression coefficient (β)	t-value	Regression coefficient (β)	t- value
Constant	2.7184	4.44	3.5799	3.90	3.0890	5.93
AP	-0.1419	1.52	0.1352	1.04	-0.1255	1.63
MS	0.0076	0.03	-0.3811	1.05	-0.1815	0.79
R^2 value	0.0205		0.0173		.0150	
F-ratio	1.22		1.03		1.81	

Table 5 focuses on the impact of 'Intellectual Ability' and 'Metacognitive Skills' (independent variables) on 'Academic Performance' (dependent variable) of the respondents. The regression analysis indicates that 'Intellectual Ability' did not contribute significantly towards the 'Academic Performance' of the rural adolescents across the two genders as well as in totality. But the second independent variable i.e. 'Metacognitive skills' was found to be positively and significantly impacting 'Academic Performance' of the rural adolescents across both the genders (t-value= 2.73 and 0.73; p< 0.01, respectively).

Table 5: Linear regression analysis of Intellectual Ability (IA) and Metacognitive Skills (MS) on Academic Performance (AP) of Rural Adolescents (N=240)

Variables	Male		Female		Combined	
	Regression coefficient (β)	t-value	Regression coefficient (β)	t-value	Regression coefficient (β)	t- value
Constant	1.6630	2.63	3.7207	6.19	2.5526	5.85
IA	0.1369	1.52	0.0680	1.04	0.0878	1.63
MS	0.7680	2.73**	0.1896	0.73**	0.3278	1.72
R^2 value	0.0792**		0.0126**		0.0246	
F-ratio	5.03**		0.75**		2.98*	

**Significant difference at 0.01
*Significant difference at 0.05

The impact was found to be more in case of boys (0.7680) as compared to girls (0.1896). Further, the in-depth analysis of the table revealed that in case of boys, 'Intellectual Ability' and 'Metacognitive Skills' together contributed 7.92 percent towards 'Academic Performance' of the adolescent boys whereas in case of girls the total contribution was found to be just 1.26 percent. However, in the combined sample of rural adolescents the contribution was found to be only 2.4 percent but non-significant. Thus, it could be concluded from the above discussion that 'Metacognitive Skillfulness' rather than 'Intellectual Ability' was a more significant factor in improving the 'Academic Performance' of the rural adolescents across both the sexes. Prins *et al* (2006) [15] also reported that metacognitive skill fulness rather than intellectual ability was essential for learning when learners operate at the boundary of their knowledge. Young and Fry (2008) [31] also examined the metacognitive awareness to determine how it relates to broad and single measures of academic achievement in college students. Significant correlations were found between the metacognitive awareness and broad measures of academic achievement. The 'knowledge of cognition' factor of the metacognition was correlated with GPA and end of course grades. The same is true for the 'regulation of cognition' factor. These results also validate that metacognition relates to academic measures.

Kaur and Kaur (2017) [11] also investigated the academic achievement in relation to metacognition and problem solving ability among secondary school students. The findings of the study revealed that there exists no significant difference in metacognition and problem solving ability among girls and boys of CBSE and PSEB school students belonging to medical stream. Also, no significant interaction effect of metacognition and problem solving ability on achievement of secondary school students belonging to medical stream was found. Table 6 represents the impact of 'Intellectual Ability' and 'Academic Performance' (independent variables) on 'Metacognitive Skills' (dependent variable) of the respondents. The regression analysis indicates that 'Intellectual Abilities'(independent variable) did not contribute significantly towards the development of 'Metacognitive Skills' (dependent variable) among rural adolescents across both the genders as well as in totality.

Table 6: Linear regression analysis of Intellectual Ability (IA) and Academic Performance (AP) on Metacognitive Skills (MS) of Rural Adolescents (N=240)

Variables	Male		Female		Combined	
	Regression coefficient (β)	t-value	Regression coefficient (β)	t-value	Regression coefficient (β)	t-value
Constant	1.8466	15.68	2.3079	18.59	2.0463	24.04
IA	0.0007	0.03	-0.0243	1.05	-0.0145	0.79
AP	0.0781	2.73**	-0.0241	0.73	0.0375	1.72
R^2 value	0.0610*		0.0127		0.0163	
F-ratio	3.80*		0.75		1.96	

*Significant difference at 0.05
**Significant difference at 0.01

However, it was found that 'Academic Performance' had positive and significant impact on the quality of 'Metacognitive Skills' of rural boys (t-value =2.73; p<0.01). This indicates that as the 'Academic Performance' improved the quality of 'Metacognitive Skills' also improved in case of rural boys. But this significant impact was found missing in case of rural girls as well as in the combined sample. Also, the 'Intellectual Abilities' and 'Academic Performance' together contributed 6.10 percent towards the development of 'Metacognitive Skills' of the rural boys. Therefore, it could be concluded that both the independent variables (IA and AP) had non-significant contribution towards the development of 'Metacognitive Skills' of rural adolescents. Further, the figures presented in the foregoing tables (5 and 6) suggest that irrespective of gender 'Metacognitive skills' significantly impacted 'Academic Performance' of the rural adolescents and also, some reciprocal impact of 'Academic Performance' on 'Metacognitive Skills' was observed in case of boys. This reciprocal impact could be attributed to the motivation of academically high achieving boys to do even better by way of furthering their knowledge and regulation of their metacognitive skills. The overall analysis implies that many students could benefit from the enhanced awareness of the factors affecting their grades and the strategies they can employ to get better grades. Therefore, by becoming self-directed learners they can direct their efforts in the right direction to attain the goals they have set for themselves.

Researches also suggest that the development of metacognition begins around five to seven years of age and is enhanced during and through schooling (Flavel 1985; Flavell *et al* 1995; Garner 1990) [3, 4]. Although cognitive skills are important, Wagner and Sternberg (1984) [29] argued that teaching needs to emphasize metacognitive skills because generally students have a history of blindly following instructions. They have not acquired the habit of questioning themselves to lead to effective performance on intellectual tasks. Also, Students with the greatest metacognitive skill deficiencies seem to have no idea what they are doing when performing a task. Schunk (1991) [20] proposed that self-regulating students engage in learning activities with specific goals in mind, observe their performance as they work, evaluate progress in attaining their goals and react by continuing or changing their approach as needed, depending upon the value of the task and upon perceived self-efficacy.

5. Conclusion

The overall review of these tables reveals that irrespective of gender if students have well developed metacognitive knowledge and metacognitive regulatory skills and they use their metacognition, they will excel academically. Consequently, it is important to use various techniques to assess the metacognition of students and develop means by which to improve students' metacognition when necessary. Hence, it is important to screen students who have little awareness of how they learn and how to regulate their learning (passive learners) and are in need of direct instruction related to metacognition. This is especially important in large classes where teachers have little opportunity to get to know their students on an individual basis. Thus, they can determine what type of metacognitive knowledge and regulatory skills the students utilize while learning.

Therefore, for improving the academic performance, efforts need to be directed to develop and improve the metacognitive awareness and skills among students independent of their intellectual ability.

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